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A break through in impression making: A comparative study

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Abstract
Introduction: The surface details and dimensional accuracy of the cast obtained after taking impressions are essential aspects of the success of fixed prosthodontic treatment. Dental impressions can be made with a variety of elastic materials, including hydrocolloids and synthetic elastomers like polysulfide, addition silicone, condensation silicone, and polyether. These many impression materials are all employed to produce replicas of oral tissues.
Aim and Objectives: This study intends to evaluate and compare the surface detail production of 4 different impression materials; alginate (Single mix), polyvinyl siloxane impression material (1 step), alginate (Tray and injectable type), alginate (Double mix)
Material and Methodology: In the present study, a total of 20 samples were poured for assessing surface detail production, of the following groups: alginate (Single mix), polyvinyl siloxane (1 step), alginate (Cavex: Tray and injectable type), and alginate (Double mix) with standard stainless-steel die (ADA specification 9). Dimensional accuracy was determined by measuring the distance between X and X' of line B using a stereo zoom microscope (Olympus) under 30X magnification using Scopus Image 9.0 software. Measurements were recorded and the average value was taken and compared to the original length of the metal die.
Results: Group 2 showed the highest mean value followed by Group 4. The results of the study confirmed the hypothesis that different impression materials affected accuracy in a way that double-mix alginate was followed by the addition silicone as the most accurate impression material.

Keywords: Dental impressions, dimentional accuracy, polyvinyl silicane impression

1. Introduction
For the fabrication of accurate indirect restorations, accurate casts of intraoral hard and soft tissues are necessary. Undistorted impressions of the prepared tooth are necessary, which can only be obtained with a thorough knowledge of impression materials, their properties, and manipulation processes. Aside from choosing appropriate impression materials and trays, impression technique is also essential to achieving the best dimensional accuracy [1].
Dental impressions can be made with a variety of elastic materials, including hydrocolloids and synthetic elastomers including polysulfide, condensation silicone, addition silicone, and polyether. These materials are all used to fabricate restorations by reproducing oral conditions. Alginate was first introduced in 1936 (Starcke, 1975), and it was first employed as an impression medium in 1947 (Hansson and Eklund, 1984). Since then, it has become the most often utilised material as it is inexpensive, simple to use, and highly accepted by patients [2, 3]. Alginates are generally supplied in powder form, and when combined with water, they turn into a gel. The powder comprises sodium or potassium alginate (soluble alginates), zinc oxide and diatomaceous earth (fillers), calcium sulfate (activator), potassium fluoride and titanium (accelerator), sodium phosphate (retarder), and calcium sulphate (activator) However, there have been several advancements in the alginate impression material. It was previously only available in tray consistancy, it is now also available in injectable and tray consistency [3]. Polysulfide was introduced as the first synthetic elastomeric impression material in 1950. Its flexibility allowed for easy removal from retentive locations.

Later, in 1955, condensation silicone was introduced, which marked a development in impression materials since it did not require customized trays. polyether was the first to be produced for use in dentistry and was launched in Germany in 1965.

In 1975, further silicones were introduced with promising properties.

These impression materials are all used to create replicas of oral tissues with various properties. The purpose of this research is to analyse and compare the surface detail production of four different impression materials; alginate (Single mix), polyvinyl siloxane impression material (1 step), alginate (Tray and injectable type), alginate (Double mix).

Material and Methodology

In the present study, a total of 20 samples were poured for assessing surface detail production, 5 for each of the following groups: Alginate (single mix), polyvinyl siloxane (1 step), alginate (Cavex: tray and injectable type), and alginate (Double mix).

A standardized stainless-steel die (similar to that described in ADA specification 19), with three horizontal lines and two vertical lines (figure 1), was used for impression making [5, 6]. The study mold had three components: test block, mold, and metal raiser (figure 2). The horizontal lines were named A, B, and C. The width of each horizontal line was 0.016 mm. Two cross points at the intersection of the vertical lines with the horizontal line B were labeled as X and X', served as the beginning and end points of measurements for dimensional accuracy [5, 6].

Fig 1: Lines inscribed on ADA specification 19 stainless steel die.

Fig 2: Components of ADA specification 19 stainless steel

Impressions of the test block were made in four groups (n=10 each) according to the type of impression material used.

Group 1(G1) is conventional alginate (single mix) impression, The traditional alginate was hand-mixed in a rubber bowl at the manufacturer's suggested L/P ratio. The mixture was stirred in one direction using a plaster spatula for 45 seconds against the bowl walls to achieve air bubble-free, homogeneous mix with a uniform colour. The mixture was placed into the stainless-steel die and allowed to set. The dental stones (type IV) were mixed according to the manufacturer's instructions before being put to the impression in modest increments and allowing the material to set.

Group 2 (G2) is polyvinyl siloxane impression (double mix single step), equal amount base and catalyst was mixed and at the same time using a fine-tipped impression syringe light body material was applied to the die, the tip of the syringe was kept in contact with lined areas and the material was pushed ahead of syringe tip and then heavy body impression was loaded on the top and sufficient pressure was applied. Once the material was set the impressions were poured the same like that of group 1.

Group 3 (G3) is dual consistency alginate impression (Cavex/Holland), the creamy and normal set (tray consistency) alginates were mixed simultaneously according to the manufacturer's instructions. The creamy alginate was poured into the die followed by the normal (tray) alginate and the material was allowed to set. Once the material is set impressions were poured like that of group 1.

Group 4 (G4) is conventional alginate impression material used in two consistencies. This alginate is mixed into two consistencies; the first mix is syringing consistency and the second mix is tray consistency. The syringe consistency alginate is first added onto the die followed by tray consistency and allowing the material to set. Once the material is set impressions are poured like that of group 1.

Dimensional accuracy was determined by measuring the

distance between X and X' of line B using a stereo zoom microscope (Olympus) under 30X magnification using Scopus Image 9.0 software. Measurements were recorded and the average value was taken and compared to the original length of the metal die.

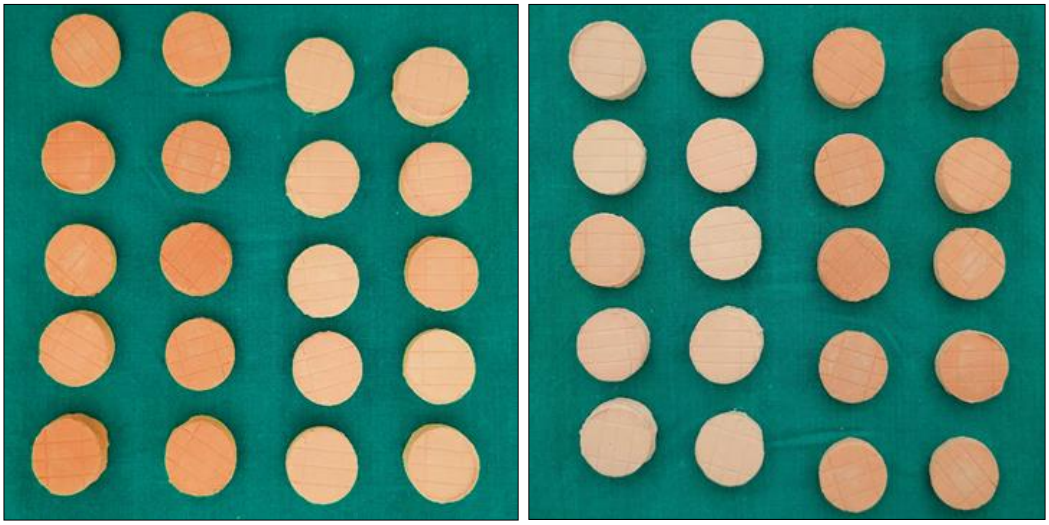

Fig 3: Samples

Statistical analysis

Data collected were entered into an Excel sheet and analyzed using the IBM SPSS statistics 20.0 (IBM Corporation, Armonk, NY, USA). Results on continuous measurements was presented on Mean SD. Level of significance was fixed at p=0.05 and any value less than or equal to 0.05 will be considered to be statistically significant. Kolmogorov Smirnov test was used to check the normality of the data.

One-way Analysis of variance (ANOVA) was used to find the significance of study parameters between the groups and within the groups. Further post hoc Bonferroni analysis was carried out as the values of ANOVA test were significant.

Descriptive statistics were calculated. It included Mean, Standard Deviation, Median, minimum and Maximum Values. Mean was highest for Group 2 (Polyvinylsilaxane) and lowest for Group 1 (Conventional Alginate). Median for Group 1 was (172.5), Group 2 (178), Group 3 (176), and Group 4(177).

Results

Fig 4: Group 1

Fig 5: Group 2

Fig 6: Group 3

Fig 7: Group 4

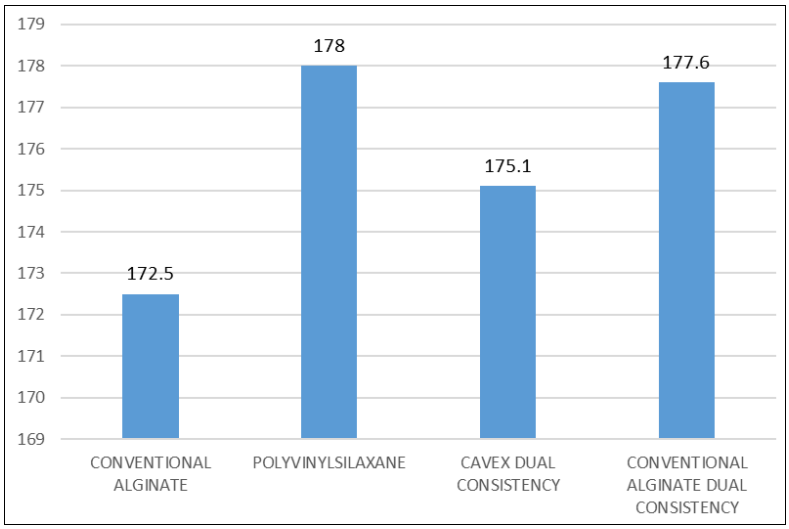

Fig 7: Mean of Groups

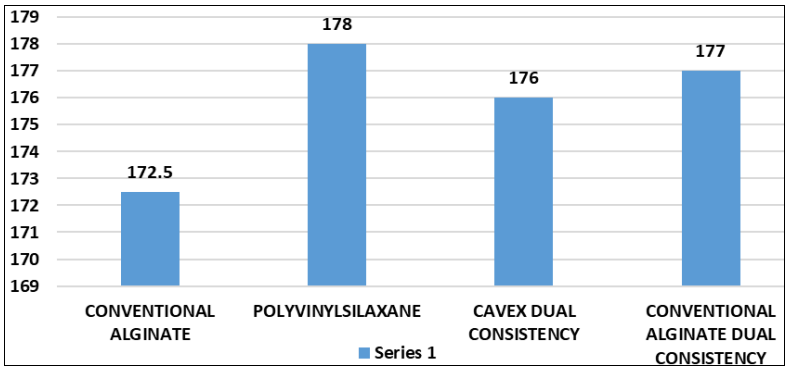

Fig 8: Median of Groups

Table 1: Shows in group conventional alginate, Polyvinylsilaxane**,** Conventional alginate dual consistency

	Group 1 (Conventional alginate)	Group 2 (Polyvinylsilaxane)	Group 3 (Cavex dual consistency)	Group 4 (Conventional alginate dual consistency)
Mean	172.50	178.00	175.10	177.60
Standard deviation	1.650	2.108	1.72	2.366
Median	172.50	178.00	176.00	177.00
Minimum	171	174	172	172
Maximum	176	181	177	179

Table 2: One-way ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	175.500	3	58.500	15.261	.000**
Within Groups	138.000	36	3.833		
Total	313.500	39			

Table 3: Shows in group conventional alginate, mean difference

(I)Group	(J)Group	Mean Difference (I-J)	Std. Error	Sig.
Conventional Alginate	Polyvinyl siloxane	-5.600*	.876	.000**
	Cavexdual Consistency	-2.400	.876	.057
	Conventional alginate dual	-4.200*	.876	.000**
Polyvinylsilaxane	Consistency Conventional	5.600*	.876	.000**
	Alginate Cavexdual Consistency	3.200*	.876	.005*
	Conventionalgi nate dual consistency	1.400	.876	.711
Cavexdual Consistency	Conventional Alginate	2.400	.876	.057
	Polyvinylsilaxane Conventional	-3.200*	.876	.005*
	Alginatedual Consistency	-1.800	.876	.283
Conventional alginate dual Consistency	Conventionalalgi nate	4.200*	.876	.000**
	Polyvinylsilaxane	-1.400	.876	.711
	Cavexdual Consistency	1.800	.876	.283

(p<0.001- Highly significant**)

Descriptive statistics were calculated. It included Mean, Standard Deviation, Median, minimum and Maximum Values. Mean was highest for Group 2 (Polyvinylsilaxane) and lowest for Group 1 (Conventional Alginate). Median for Group 1 was (172.5), Group 2 (178), Group 3 (176) and Group 4(177). One-way Anova was performed and highly significant results were seen in between the groups and within the groups.

Bonferroni Post Hoc Test
(p<0.001- Highly significant)**
Post Hoc Bonferroni was done for multiple comparisons. Highly significant results were seen between Group 1-Group 2 and Group 1- Group 4. Significant results were seen between Group 2-Group 3.

Discussion

To generate a high-quality impression, the right impression materials and procedure must be used. Material science advancements and the development of various techniques have all contributed to achieving these needs [1]. As a result, accuracy and perfect reproduction of details are essential for producing accurate prostheses [9]. In prosthodontics, making alginate impressions is a common process.

These impressions must be accurate in order to generate dental casts with nearly the same dimensions and details similar to oral structures. Alginate impressions, despite their ease of manipulation, generally exhibit certain dimensional changes due to their polysaccharide structure. These materials are commonly prone to fluid uptake and loss due to their structure, in hereditary phenomena known as imbibition and syneresis. Both actions are always detrimental to impression dimensional stability [7]. Elastomeric impression materials are a class of flexible chemical polymers that are cross-linked either physically or chemically. When the imposed stress are reduced, these materials can be easily stretched and quickly recovered. Elastomeric impression materials are available in a range of viscosities, from very low viscosity putty to

extremely high viscosity putty (Donovan & Chee 2004). Because of the increased polymerization shrinkage, monophasic addition silicones do not provide the same level of accuracy as a combination of low viscosity/high viscosity materials. The current research looked at the dimensional accuracy of four different impression materials. Because of its inexpensive cost and ease of usage, alginate is the most commonly used in dental clinics [4]. The dimensional accuracy of three different alginate consistency samples were analysed in this study: conventional alginate, cavex dual consistency, conventional in dual consistency, and putty light body.

The results of the study are in accordance with the study conducted by Adriana Cláudia Lapria Faria *et al*. Confirming the results of the studies cited above, in the present study alginate presented an accuracy similar to that of elastomeric impression materials, suggesting that alginate can be used to replace some elastomeric impression materials like polyvinlysilocane impression following the double-mix technique Alginate's instability over time and surface roughness due to water loss are limitations that limits its application to diagnostic casts. However, in the current investigation, Alginate behaved similarly to polyvinylsilaxane, which could be explained by the substance's dual consistency nature, in which syringe consistency alginate serves as the light body and tray consistency alginate serves as the putty body.

Conflict of Interest
Not available

Financial Support
Not available

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